The Tiqit eightythree

Desktop functionality on a handheld

Stanford Wearable Computing Lab

- Vision: The truly mobile full PC
  - 1998: Going-in premise: x86 architecture
  - Benefits: Huge software base, familiar platform, commodity space
- Matchbox Webserver: 1 cu.in. Linux-based server
  - In Guinness Records 2000-2002 as smallest webserver
  - Basis for Jumptec's DIMM-PC advertising at CeBIT'99
- Matchbox PC: 5 cu.in. Windows-based PC
  - Finalist in 2001 Computerworld Honors Symposium (mfg.);
  - Other finalists: Boeing, Dell, Delphi Automotive, **NTT DoCoMo**.
- Shortcomings: feeble and uncivilized
- Vision+: these shortcomings can be overcome!

Stanford Wearable Computing Lab

Is this vision commercially viable?

- Tiqit Computers formed March 2000 to find out.
- Requirements:
  - A talented and committed team
  - Good balance of engineering and business skills
  - A clear but flexible vision of market, mfg, & users
  - Adequate resources (funding, space, etc.)
  - Smiling gods (time and chance happeneth to them all)
- Additional feature:
  - Maintain a working relationship with a local university
  - Achieved here by maintaining the lab's research focus (with Tiqit's market in mind as a prime application) in parallel with Tiqit's focus on commercial viability.

Wireless for Handheld Computing

Majid Emami, EE PhD

Mobile antenna design

1. Fast Maxwell's equation solver
   - Trick: Maintain locality of constraint propagation via relativistic invariance of Maxwell's equations
   - Equally applicable to time & frequency domains
2. Higher bandwidth through holographic propagation
   - Relies on multiple transmitters & antennas + scattering
   - Better immunity to transient obstructions & noise
   - Adapts standard technique to handheld computers

Speech for Handheld Computing

Keyvan Mohajer, Ramon Prieto, EE PhD

Robust Speech Front Ends

1. Structure of the glottal cycle
   - Front ends emphasize frequency domain
   - One benefit: tunes out noise
   - Benefit neutralized by glottal closure GC
     - GC rephases formants, creating its own noise
   - Solution: Wavelets – intermediate between time and frequency
   - RRRA: Rapid Response Resonance Analysis
     - Technique for tracking intracycle frequency variation
     - Impossible with DFT (meaningless in frequency domain)
     - Benefit: improved consonant recognition

Speech for Handheld Computing

Robust Speech Front Ends

2. Backend Calibration of Front End Tuning
   - Front end tuning useless unless the backend benefits
   - Testbed backend: HTK (thank you MS!)
   - Need stationary back end to judge moving front end
   - Nontrivial problem to stabilize the back end in a research environment: half our front end work is on the backend as instrument calibration. Unexciting but necessary.



Tiqit Computers, Inc.

A Different PC Perspective

April, 2002

The challenge: Design a fully-functional general purpose handheld computer.





Why?

- Many mobile applications are poorly served by existing products; people currently use a laptop or no computer at all.
- Currently, a handheld solution is not available that allows customers to leverage their existing x86 software code base.
- For many applications, a properly designed x86 handheld can replace a laptop.



Existing mobile products fall into four categories:

- PDAs
- Laptops
- Webpads and Tablet PCs
- Special-purpose industrial computers

PDAs



- Excellent for prescribed set of tasks
- Small, lightweight, low hardware costs
- Long battery life (PIM applications only) and instant wake capability

BUT

- Limited hardware architecture (StrongARM, XScale)
- Limited applications, incompatible with existing x86 software
- Specialized expansion and peripherals
- OS forces expensive software porting

Laptops



- Full desktop capabilities
- Full range of expansion and peripheral options
- Leverage existing x86 software & infrastructure

BUT

- Large, heavy device
- Must unfold laptop before use
- Must place on a table or other surface to use

Webpads and Tablet PCs



- OS and software compatibility
- More mobile than laptops
- Large screen



BUT

- Many applications require keyboard and mouse
- Still much larger than handhelds
- Users often hostile to pen-only interfaces

Special-purpose Industrial Computers

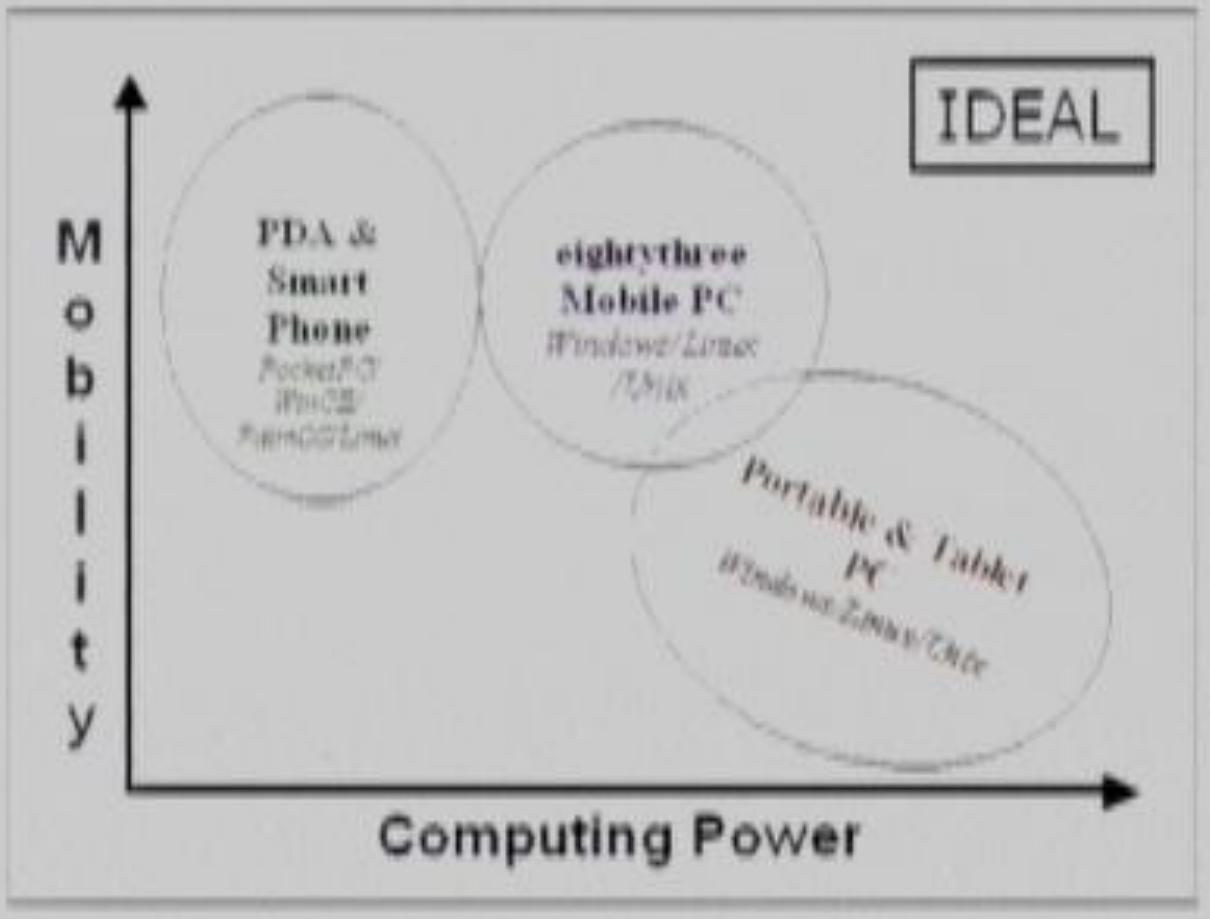
- Designed to solve certain problems well
- Good ergonomic match for specific application



BUT

- Expensive
- Inflexible
- Cannot always use existing x86 software

Tiqit eightythree: fills the void between PDAs and Portable/Tablet PCs.





What are the minimum requirements for a general purpose handheld PC?

- Support operating systems currently in use on desktops and laptops
- Compatible with today's existing applications
- Comfortable and usable despite small size
- Able to use existing laptop peripherals and expansion hardware
- Battery life at least equivalent to that of modern laptops

Technical requirements that this translates to:

- x86 compatible processor, at least 300 MHz
- At least 128 MB of OS-available SDRAM
- At least 5GB of hard disk space
- VGA or better screen in landscape mode
- Keyboard
- Mouse or equivalent cursor control
- Standard connectivity
- Laptop-class Lithium Ion battery

What is "standard" connectivity?

- Legacy data: RS232, Parallel, PS2, RJ11, RJ45
- Modern data: USB (1.1/2.0), 1394, IRDA
- Audio: Headphone, Mic, Line In/Out
- Video: VGA, NTSC, Composite, S-Video, DVI
- Expansion: PCMCIA / PC Card / Cardbus, mPCI
- Flash: SD/MMC, SM, Memory Stick, CF

eightythree target specification



- 300 MHz processor (WinXP 233-300)
- 256 MB RAM (WinXP 64-128)
  - Need to allow for CPU and/or video to steal RAM
- 5-10 GB hard drive
- 3.5mm Headphone, 2.5mm "earbud" jacks
- Cardbus, USB, Power, SD/MMC, IRDA
- High density docking: VGA, Line In/Out, another USB, RS232, another Power, Dock Sense



Design Tradeoffs

- PCB size vs. PCB cost
- PCB part size vs. part availability & cost
- Processing power vs. size, heat, battery life
- Battery life vs. size & weight
- Overall size vs. feature set
- Vertical market vs. general purpose

Engineering Challenges I



- Space and mechanical integration
  - Final form factor 5.4 x 4 x 1.1" (137 x 102 x 29mm)
- Heat
  - Patent-pending method of dissipating heat through magnesium alloy case - passive cooling only
- Assembly
  - Design for manufacturing - optimized for assembly
- Force sensitive joystick
  - Integrated cursor control on handheld

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Engineering Challenges II



- Motherboard density
  - Standard CPU + chipset architecture infeasible
  - Use BGA/CSP IC packages where possible, but avoid pre-production or otherwise expensive parts.
  - Low profile constraints a serious problem
- Power Supply
  - 5 switching power supplies in spaces far smaller than usual designs. Production-ready EMI filtering and fusing also caused space problems.
  - Small size makes routing and shielding difficult.

eightythree user interface



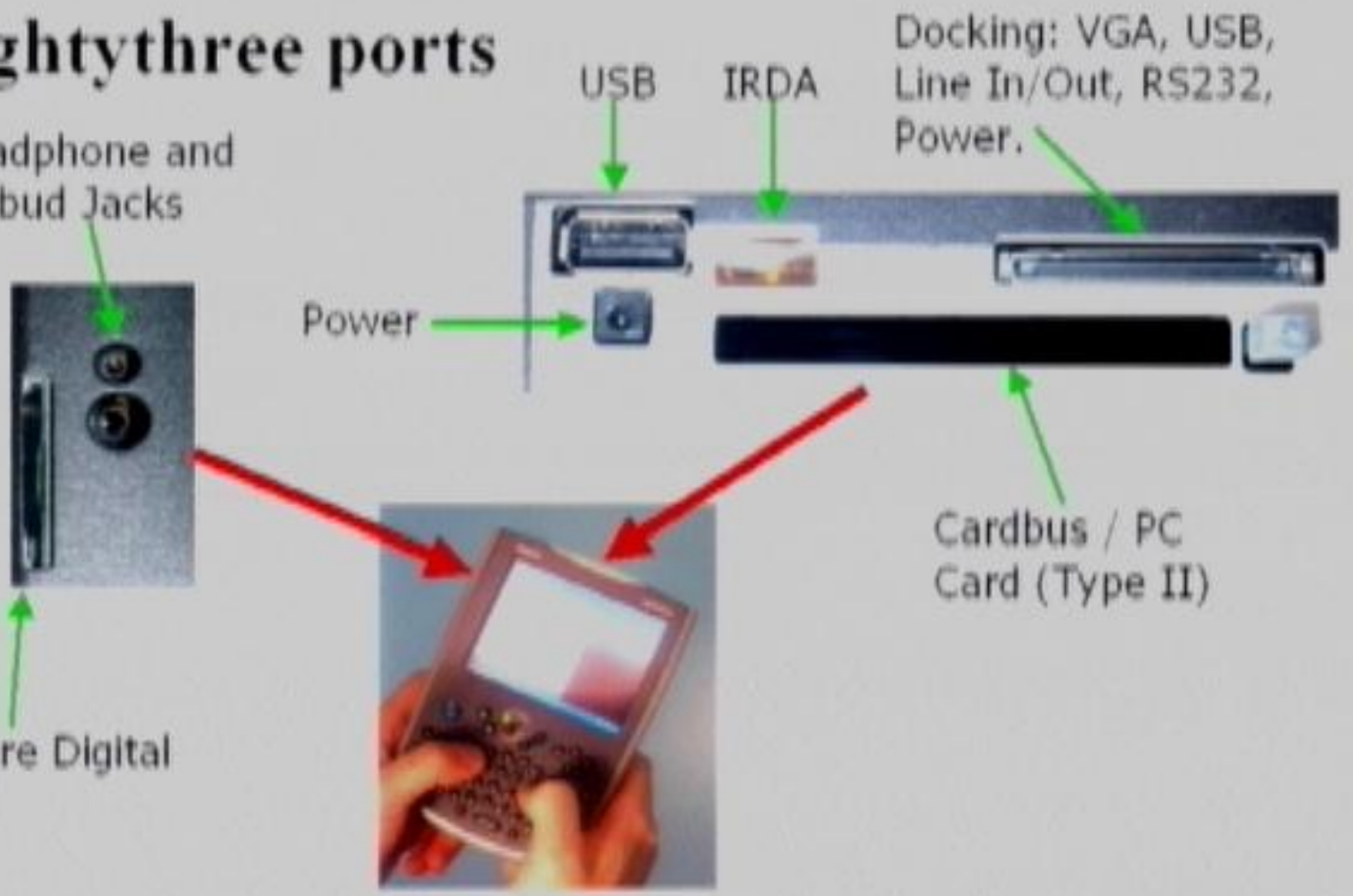
Force-sensitive mouse stick

56-key SMS-type keyboard

640x480 color TFT w/CCFL backlight and touchscreen

Mouse buttons and cursor keys

eightythree ports



Benefits of the eightythree solution



- Enterprises are able to deploy handhelds running their existing software packages.
- Full line of PC Card wireless solutions allow device to be customized as needed.
- CPU and disk space on handheld allow for local processing and elimination of middleware.
- Security, PKI and VPN software works without the need for custom handheld solutions.
- Total cost of ownership lower due to shared infrastructure (SW, training, support) with other PCs.

The eightythree is also a mobile thin client



- Equivalent to Thin Clients like the Compaq Evo T20.
- Allows organization to purchase one machine per person: fixed thin clients for non-mobile workers, eightythrees for mobile workers.
- Single-point docking connection for use with full-size monitor, keyboard, mouse, loudspeakers and network.

IBM Metapad and Acqis iMod





- Metapad and iMod are transportable cores
- Core by itself has no user interface or power supply.
- Using the Metapad core to make a handheld results in higher costs and larger size
- Transportable core without an industry standard locks customers into complete set of computer components from a single supplier.

Comparison with OQO's computer

- OQO PC is an eightythree without the PC card, keyboard, joystick and SD slot, with a smaller battery.



- Tiqit takes the position that what the market needs is a handheld carefully optimized for use with existing applications, not a transportable core with a minimal interface.
- OQO uses a TM5800 for increased speed (clocked down when mobile). Tiqit evaluating this option.

Tiqit Computers Inc.



- Computer design company located in Redwood City, California.
- Founded March 2000
  - Vaughan Pratt - Chairman
- Executive Team
  - Henry Berg (President) and Ian Blasch (CEO)
- 9 employees
- Angel Funded
- Product Development
  - Zorro – Proof of Concept (Completed Aug 2001)
  - eightythree – Production Product (Prototypes Available)


TIQIT